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Our Research Institutions at a glance: TurboBeads

Following an ETH patent application and widespread interest in a magnetic nanomaterial described in an Angewandte paper in 2007, TurboBeads GmbH was founded by Wendelin Stark and Robert Grass as an ETH Spin-Off. The company was established to make the new, and unique carbon coated nanoparticles available to research institutions and companies throughout the world.

TurboBeads Llc. follows a lean company strategy, and apart of the 20'000 CHF required for company registration in Switzerland has grown solely by profits gained from real customers. This approach was greatly assisted by the interest of some multinational corporations with whom TurboBeads has continued to develop magnetic nanomaterials.

Currently TurboBeads has three areas of operation:

- Manufacturing of magnetic nanomaterials and catalysts for use in chemistry. These materials are currently distributed via Sigma-Aldrich and Wako (in Japan).
- Manufacturing of magnetic nanomaterials and separation solutions for use in biochemistry and bioanalytics. These products are either sold online directly via www.turbobeads.com or through selected collaborating companies.

- Development of heavy metal recovery solutions from aqueous waste streams in collaboration with the corresponding industries.

TurboBeads has collaborated with several research institutions within the Mag(net)icFun network with the goal of extending the application range of the original materials. It is believed that this scientific interaction greatly helps in keeping the products and services up-to-date and helps in making magnetic separation available to many new fields.

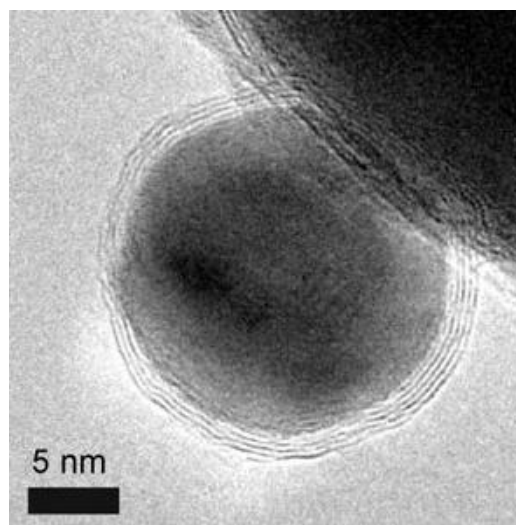


Figure 1. Cobalt carbon coated magnetic nanoparticles developed by ETH.

Students leaving the network

Dr. Antonella Lisella, (MICA Biosystems and Keele University, MICA, UKEE): From May 2013 till April 2015 I joined the ITN Mag(net)icFun as a Postdoctoral Fellow. During this time I have been working at MICA BioSystems (spin off company of Keele University), at Keele University and I also had the opportunity to moved into Germany as part of the secondment plan envisioned by the network.

Through MICA BioSystems, I have developed magnetic nanoparticles (MNPs) coated with two different biomolecules: a tripeptide of L-arginine, glycine, L-aspartic acid (RGD), and TREK1 antibody. **RGD** can be attached on the cell membrane via integrins receptors with the purpose of **binding the nanoparticles on the extracellular side**. TREK1 is a member of the potassium channels; this mechano-

receptor is characterized by sensitivity to different stimuli, such as: membrane stretch, temperature and pH. In addition, TREK1 channels have a biological importance because are implicated in many cellular transduction pathways. **TREK1** coated MNPs were used in combination with a liposomal transfection agent in order to **bind the nanoparticles at the intracellular side of the cells**.

The developed bio-functionalized MNPs were used to stimulate and manipulate the Caco-2 cell line. Our results confirmed the successful cell activation with the prepared bio-coated MNPs. In particular, the improvement of drugs permeability through the cell monolayer demonstrated the effective binding of the particles on the cell membrane.

The successful manipulation of cells by using MICA technology has supposed a great example of the potential of using magnetic nanoparticles in both biological and medical fields, thus MICA BioSystems has been awarded by the UK Technology Strategy Board (TSB) and has been funded to continue with the project.

In order to further study the effect of the prepared MNPs on the cell membrane, I carried out the morphology studies of the tight junctions (TJ) in Caco-2 cell at Keele University. The integrity of the cell monolayers was not affected by the presence of bio-coated MNPs and their magnetic stimulation. However, when the Caco-2 cells were stimulated in

presence of bio-coated MNPs, the TJ displayed a ruffled membrane. After the 2 h of magnetic stimulation, the cells were incubated at 37°C for 12 h. Within the 12 h, the ruffled morphology reverted back to the normal TJ cobblestone morphology, indicated the reversibility of the TJ remodelling. The TJ rearrangement process indicates that established dynamic conditions remodel the TJ and enhance the paracellular pathway for drug transport.

Then, the cell uptake studies of the prepared bio-coated MNPs were carried out. The MNPs were additionally functionalized with Rhodamine RedTM-X in order to be observed by confocal microscopy. The RGD-MNPs were not internalized by the cell within 24h, indicating that the particles were specifically attached on the cell membrane.

Finally, I worked on the cytotoxicity tests of the nanoparticles produced within the network. For that I moved into the University of Regensburg (Germany) where I joined Prof. Reiser's group for one month.

Further than the research projects I was developing on the different institutions, to be a member of the Mag(net)icFun network has supposed to be enrolled in a continuous training program where mobility has been a 'must' giving us the opportunity to set up new researcher networks and potential collaborations.

I am delighted to be part of this ITN which has been crucial for my professional and personal development.

Opportunities in the network

Dina Niculaes, (Italian Institute of Technology, IIT): In June 2015, Dina Niculaes, one of our ESR, attended the 65th Interdisciplinary Lindau Nobel Laureate Meeting as a Young researcher, upon nomination by the European Commission, Marie Skłodowska-Curie Actions. This year, 65 Nobel Laureates and 650 young researchers participated in that Interdisciplinary Meeting, covering the fields of Medicine or Physiology, Chemistry and Physics. The meeting was all about exchanges between the Young Researchers and the Nobel Laureates, through lectures in the morning, master classes and discussion sessions

in the afternoon and formal and informal get-togethers in the evening.

The Lindau Nobel Laureate Meeting, just as 2014 Chemistry Laureate Eric Betzig said about the Bell Laboratories, 'was a place where you could meet people from other fields, with a very low activation energy' in order to share ideas, get inspired and connect. The take home message that resonated with Dina the most, and that throughout the meeting was expressed by various Laureates, was nicely summed up by the 2011 Physics Laureate Saul Perlmutter: 'Science is about being open to being wrong', a growth mindset at its best.

250th American Chemical Society National Meeting & Exposition

As part of the training programme envisioned by our Mag(net)icFun consortium, on August 16th-20th our students had the opportunity of attending to one of the biannual meetings of the American Chemical Society, which is considered one of the biggest conference all around the world.

Our network was participating in the event with

nineteen scientific presentations, giving by both, students and PIs, as well as with the organization of the symposium 'Magnetically Recyclable Nanocatalysts' presided by two of the PIs of the network, Prof. Reiser and Prof. Pericàs'.

These are some general impressions taken from our students:



Kaarjel Naravanasamy (UKEE): ‘The conference itself was very large with many parallel sessions. I attended a workshop for career paths in higher education but it was mainly geared towards researchers looking for job opportunities in USA. The workshop held by Elsevier on ‘how to publish papers’ was very informative and provided good tips on how to promote one’s research. The exhibition booths were useful as there were many companies promoting their products and I managed to find a company that sold TGA crucibles for a tenth of the price usually sold online’.



Figure 2. Mag(net)icFun’s students and PIs at the main entrance of the Boston Conference and Exhibition Center.

Dalibor Soukup (UKEE): ‘I was pleasantly surprised with how well such a big conference was organized. Due to the fact that the conference offered so many parallel sessions, it was easy for me to find

talks that I was truly interested in. As for my presentation, I was eternally grateful to be given the opportunity to deliver a podium presentation at such a conference’. ‘The icing on the cake at this conference was that I was a winner for one of the lucky draw contests and I will receive a custom designed ACS lab coat’.

Francesca Besostri (UREG): ‘We had the chance to attend to lectures of prestigious chemists and to exchange information with other researchers and experts about our work in the network, which I think is very important to make a break-through in any field’.

There was time for science but also time for fun...



Figure 3. Mag(net)icFun’s students and PIs at the main entrance of the Boston Conference and Exhibition Center.

News from the network

- The specific dates for the next workshop of Mag(net)icFun are from March 3rd until March 4th at the Trinity College, Dublin (Ireland).
- Fellows publications of the network: <http://www.magneticfun.eu/publication.php>

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